Research Articles

Development of a Food Checklist for Fat, Saturated Fat, and Sodium for Middle School Students

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We developed a brief, inexpensive, culturally sensitive 24-hour food checklist to identify middle school students enrolled in the Child and Adolescent Trial for Cardiovascular Health (CATCH), whose food choices over the previous day were high in total fat, saturated fat, or sodium. Food checklists were coded from 224 24-hour recalls previously collected from CATCH students in the fifth grade to simulate responses to it. Administration procedures for the food checklist were then pretested on 71 schoolchildren in grades 6 through 8. Regression results indicated that consumption of 10 items on the checklist had a positive effect on fat intake; 13, on saturated fat; and 11, on sodium intake. Some foods were removed from the checklist because of their small effect size or infrequency of reported consumption; others were combined or subdivided to form new food groups, or were reworded to improve comprehension. The final food checklist consisted of 40 foods or food groups. The median same-day test-retest reliability Kappa was 0.85; item validity, as measured by the median Kappa statistic, was 0.54. The food checklist procedures described may be helpful for developing similar food checklists. Nutrition educators and teachers may find that the food checklist is a useful educational tool for informing students about their fat intakes.

Although 24-hour recalls and food records are the most accurate of the dietary assessment methods available, they require a great deal of instruction and are too expensive and burdensome to use in large-scale community studies (28). Thus brief, inexpensive, valid, culturally appropriate dietary assessment instruments that can be used to categorize children's relative intakes of nutrients are needed. Food checklists are useful in large-scale studies for detecting changes in food choices and for quantifying and ranking individuals' intakes of specific nutrients. When used to assess the prior day's food consumption, food checklists can be calibrated by comparing results with 24-hour recalls.

The Child and Adolescent Trial for Cardiovascular Health (CATCH) was a large-scale, school- and family-based, multicenter intervention trial aimed at decreasing cardiovascular risk factors and making organizational-level changes. The cohort consisted of elementary schoolchildren and their schools. Details of the CATCH study are described elsewhere (21). Particular attention was directed at educating children on positive eating behaviors to improve and lower intakes of sodium, total fat, and saturated fat (19).

A food checklist was designed as a short, inexpensive diet assessment tool to detect differences between the target nutrients in the diets of the

CATCH cohort as they were followed longitudinally. Use of a checklist appeared promising, but existing checklists were either inappropriate for children or the targeted nutrients differed from those of interest in CATCH. For example, Kristal and colleagues (14) used a 19-item checklist of foods high in fat and fiber—although neither saturated fat nor sodium was included—to study women's intakes. For 16 foods, Kappa values exceeded 0.6 when food items reported on the checklist and 24-hour recalls were compared.

In students followed from the sixth through the twelfth grades in the Class of '89 Study, an 18-item scale or paired food choice was used (13). This scale detected differences in high-fat food choices between students residing in intervention and control communities, and scores suggestive of a preference for high-fat foods correlated well with lack of exercise and smoking (12,13,17,20). Middle school students in the CATCH intervention group differed from controls on their usual choices between food pairs on the Health Behavior Questionnaire (16). However, items on the Class of '89 and the CATCH Health Behavior Questionnaire food-choice scale asked subjects to indicate which of two food pairs they usually choose rather than asking them to report their food consumption.

The purpose of this study was to develop a brief food checklist to report intakes of foods that were major contributors to middle school children's intake of fat, saturated fat, or sodium over the previous day. This checklist needed to be inexpensive, culturally sensitive, and suitable for administration in group settings to a multiethnic group of middle and junior high school students.

Methods

Sample

The data we used consisted of 224 24-hour recalls, 56 at each of the four CATCH sites: San Diego, CA; New Orleans, LA; Minneapolis, MN; and Austin, TX. These recalls were selected randomly from all 1,182 recalls collected in the CATCH study after stratifying by site when the cohort children were in the fifth grade, in the spring of 1994. The multiethnic sample reflected the composition of the CATCH population: 44 percent females and 56 percent males; 68 percent White, 13 percent Black, 15 percent Hispanic, and 4 percent Native American, Asian American, and others. The sample size was selected to permit us to detect reliably food-item effect sizes of 0.35 or greater (8), sizes we considered large enough to be of dietary importance. Effect size is the difference in mean nutrient intake levels between those who consumed a food versus those who did not, divided by the standard deviation of the measured nutrient.

Preliminary List of Foods Included on the Food Checklist

Developing the food checklist involved (1) compiling the preliminary list of foods to be included on the food checklist, (2) coding the food checklist by using previously obtained 24-hour recall information to simulate student response, (3) calibrating the food checklist to 24-hour recalls to produce a final version of it for administration, and (4) formalizing administration procedures after pretesting the food checklist administration with students.

The food checklist was a modification of a questionnaire used in the Youth Risk Behavior Survey (11), with some items from the Food Behavior Checklist

(14). It included food choices, reported by third graders in the CATCH pilot study, that were high in fat, saturated fat, and sodium and similar foods identified in other studies (3-5,10, 26,30). Other questionnaires that focused on fat, saturated fat, and sodium were also reviewed even if they were not designed for children or adolescents (1,2,6,9,11,14,24,25,29). Foods that contributed substantially to intakes of target nutrients, because they were consumed frequently, were also included (5,26,30). In addition, special attention was paid to inclusion of relevant ethnic foods.

To cluster foods into groups that were similar in their nutrient composition, we examined tables that reported food composition for total fat, saturated fat, and sodium based on nutrients per 100 grams of each food item. Items considered by themselves and items added to foods, such as butter and salad dressing, were considered for inclusion. Whenever possible, foods and groups of foods were categorized similarly to those employed on existing instruments, such as on the food frequency questionnaire of the Third National Health and Nutrition Examination Survey (NHANES III) (22) and the Block Brief Fat Screener (2).

Analysis of Existing 24-Hour Recall Records

Foods to be included in the checklist were evaluated by using a criterion-oriented approach similar to that described by Posner and colleagues (23). For this analysis, a random subsample of 224 of the records collected in 1994 from fifth grade CATCH students using 24-hour recalls was used. These recalls were collected by trained and certified CATCH interviewers who used standard techniques and a nonquantified food record as a memo prompt during their

recalls *(18)*. The Minnesota Nutrition Data System (NDS) software[1] was used to compute nutrient intakes. The food records were listed on the checklist, examined, and scored "yes" if the food was eaten and "no" if it was not. Foods on the recall that were not on the checklist were not scored. The criterion was the extent of agreement between the score on the food checklist and the intake of a specific nutrient (fat, saturated fat, or sodium) on the 24-hour recall of the previous day as assessed from stepwise linear regression.

For this study, copies of the previously collected 24-hour recalls were obtained for each of the students. Five nutritionists (one at each of the four CATCH field sites and one at the Data Coordinating Center) were trained to use standardized written instructions to code the food checklist from 24-hour recall printouts and followed these procedures. The site nutritionists then completed a food checklist for each of 56 recalls collected at each site, and the Data Coordinating Center nutritionist filled out a total of 56 food checklists (14 collected at each site). The nutritionists reviewed each food on the recall and then marked the corresponding item on the food checklist, thereby providing a simulated checklist data set for study purposes.

To evaluate inter-coder reliability, another Data Coordinating Center nutritionist coded all 224 recalls onto checklists (table 1). Agreement between the coding of the quality assurance coder and that of the five nutritionists was tested with a generalized Kappa statistic. Kappa values of 0.6 or greater are generally regarded to indicate "substantial" levels of inter-rater agreement *(15)*. Kappa values ranged

from 0.4 to 1.0, with 38 items exceeding 0.6 Kappa values. Inter-coder reliability was excellent, with Kappas usually exceeding 0.9 for individual food groups, indicating nearly perfect agreement in coding between the quality assurance nutritionist and the five nutritionists (site and Data Coordinating Center). It was recognized that nutrient correlations between children's 24-hour recalls and checklists coded by nutritionists were higher than would be found if children had completed the food checklist. In actual use, children may forget foods they have eaten or misinterpret checklist items.

Pretest of the Administration of the Food Checklist

The food checklist was administered, by using a standardized protocol, to a total of 71 nonrandomly selected sixth- (n=1), seventh- (n=60), and eighth- (n=10) grade students representative of the ethnic groups in the CATCH, with nearly equal numbers of males and females in seven groups at three of the sites (California, Louisiana, and Texas). Students were instructed to circle "yes" next to any food group or food from which they had consumed at least one bite or one sip on the previous day. They were instructed to categorize unlisted foods such as sandwiches by their separate components (e.g., bread, ham, cheese, butter), and to circle all the items that applied.

Following the administration of the food checklist, the students were asked a predesignated series of questions by a food checklist administrator to assess their understanding of instructions and the clarity of items on the checklist. Feedback from the students' observations, suggestions of the checklist administrators, and the recommendations of the CATCH Dietary Assessment Working Group were used to revise the protocol used to administer the food checklist.

Statistical Methods

Using the 224 recalls and their corresponding food checklists, we conducted a stepwise linear regression analysis to evaluate the ability of items on the food checklist to explain the variance in nutrient levels obtained with the 24-hour recalls. Individual food items were assigned a "1" if the item was checked on the food checklist and a "0" if it was not. Regression analyses were used to determine the relative contributions of individual foods or groups of foods on the food checklist (independent or predictor variables) to nutrient intakes from 24-hour recalls for each of the dependent variables (e.g., fat, saturated fat, and sodium). The regression coefficients were then converted to effect sizes (regression coefficient divided by the standard deviation for each nutrient) *(8)*.

Foods or food groups with small effect sizes (i.e., less than 0.20) for each target nutrient and those reported infrequently (by less than 2 percent of the students) were reviewed by the CATCH Dietary Assessment Working Group. Some items with small effect sizes, such as bread and cookies, were retained based on their high frequency of consumption or status as major contributors of target nutrients as indicated in other studies. Otherwise, such items were eliminated from the checklist. The food items and food categories on the food checklist were edited for readability. Further testing and validation studies as well as additional details on scoring are described in greater detail elsewhere *(27)*.

Results

The most commonly eaten foods were bread, cookies, cold cereal, and potato chips—all eaten by more than 44 percent of the children on the recall day (table 1).

Table 1. Final food checklist items with frequency of consumption, inter-coder reliability, and effect sizes on 224 middle school children

Food checklist number (final list)	Food category	Percent of children eating item[1]	Kappa values[2]	Effect sizes[3]		
				Percent Kcal from fat	Percent Kcal from saturated fat	Sodium (mg per 1,000 kcal)
22	Bread	78	0.85	•	•	•
29	Cookies	54	0.95	•	•	•
23	Cold cereal	49	0.99	•	•	•
26	Potato chips	44	0.99	0.28	•	•
14	Cheese	36	0.92	•	0.37	0.32
2	Hamburgers	34	0.92	0.49	0.43	•
39	Ketchup	33	0.94	•	•	•
3	Fried chicken	30	0.97	0.41	•	•
17	2% fat milk	30	0.95	0.42	0.56	•
21	Biscuits	30	0.97	•	•	•
31	Ice cream	27	0.94	•	0.62	•
19	French fries	26	0.99	•	•	0.24
32	Chocolate candy	26	0.96	•	0.28	•
16	Whole milk	25	0.95	0.47	0.69	•
7	Cold cuts	24	0.93	•	•	0.54
33	Margarine	23	0.90	•	•	•
35	Mayonnaise	21	0.93	0.25	•	•
12	Pizza	19	0.96	•	0.37	0.33
28	Peanut butter	16	0.98	0.38	•	•
8	Bacon	12	0.83	0.95	0.55	0.58
27	Pickles	11	1.00	•	•	0.59
11	Spaghetti with meat sauce	11	0.95	•	•	•
34	Butter	10	0.88	•	0.58	•
24	Pancakes	9	0.83	•	•	•
13	Cheese dishes[4]	8	0.87	•	0.45	•
10	Soup	8	1.00	•	•	0.86
18	Beans[5]	8	0.66	•	•	•
1	Beef	7	0.70	•	•	•
6	Hot dogs	7	0.97	0.66	0.62	0.56
37	Gravy	7	0.97	0.56	•	0.34
4	Turkey	6	0.96	•	0.41	•
38	Whipped cream	6	0.96	•	0.56	•
15	Eggs	5	1.00	•	•	•
20	Spanish rice	5	0.82	•	•	0.45
40	Salt	5	0.65	•	•	0.58
5	Meat salad	<1	0.66	•	•	•
36	Salad dressings[6]	–	–	–	–	–
9	Pork	7	0.97	•	•	•
25	Pretzels	4	1.00	•	•	•
30	Donuts[6]	–	–	–	–	–

• Effect size < 0.20.
– No scores are available because the item was originally part of another food group.
[1] Site and Data Coordinating Center coding.
[2] Quality assurance coding versus site and Data Coordinating Center coding.
[3] Effect sizes were calculated by dividing the regression coefficient by the standard deviation for each nutrient.
[4] Macaroni and cheese, cheese nachos, cheese enchiladas, quesadillas.
[5] Red, white, baked, refried.
[6] Salad dressings and donuts are included only to illustrate all items on the final checklist; these items were originally included in other groups.

Note: Foods or food groups with Kappa values <0.60 are not shown in the table.

The effect sizes show that consumption of 10 of the 40 food items/groups had a positive influence on fat intake expressed as percentage of calories. Thirteen food items/groups had a similar effect on percentage of calories from saturated fat. And 11 food items/groups had a similar effect on sodium intake per 1,000 calories. Larger effect sizes indicate a greater contribution to target nutrient intakes on the 24-hour recall. Effect sizes ranged from less than 0.2 to 0.95 (bacon) for percentage of kilocalories from fat; less than 0.22 to 0.69 (whole milk) for saturated fat, and less than 0.2 to 0.86 (soup) for sodium.

Twenty-one of the original 45 food items/groups had minor[2] effects on nutrient profiles for total fat, saturated fat, or sodium levels. These were examined further, and six items (biscuits, bread, cold cereals, cookies, margarine, and ketchup) with minor effects on nutrient profiles were retained on the checklist because they were consumed by a substantial number (23 to 78 percent) of the students. Six other items (beef, pork, spaghetti with meat sauce, eggs, and pretzels) were retained because they made substantial contributions to intakes of one or more of the CATCH target nutrients reported in other studies *(3-5,10,26,30)*.

Meat salads (e.g., tuna, chicken, or shrimp salad) and pancakes were infrequently consumed and had minor effect sizes but were retained because the older middle and junior high school students, the target population, would likely consume these foods. Canned beans (pork and beans and pinto beans) were infrequently consumed but retained because of their popularity among Hispanic-American children.

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[2]Standard deviation less than 0.2.

Six items were deleted (canned vegetables, mashed potatoes, granola, trail mix, dips, and french toast). Two food items/groups were recategorized into groups that more adequately reflected nutrient content. Cookies were divided into two groups (cookies and donuts) to narrow the range of fat content per 100 grams in each group. In addition, barbecue sauce was combined with ketchup with the rationale that this regrouping might reveal larger effect sizes in future testing with older children.

On the food checklist pretest, instructions took about 5 minutes and the food checklist took 10 minutes for students to complete. Specific references to lowfat and low-sodium foods were not included in the instructions to students, because structured feedback with students revealed that they were unable to distinguish between lowfat, fat-free, and regular food items. However, these issues were discussed in directions to the administrators. Students who ate a lowfat or low-sodium version of a food on the food checklist and asked the administrators how to complete the checklist were instructed to circle "yes" next to the checklist item. A list of commonly asked questions and standard answers for administrators was developed based on questions encountered in the pretest administration.

This developmental study was done in preparation for a validation study, which compared seventh grade students' 24-hour recalls with checklists they completed the same day. The purpose of this phase of the development was to identify the appropriate food items for the checklist. The psychometric properties of the instrument were tested after this process was completed. These and other aspects of the scoring and validation study are reported in detail elsewhere *(27)*.

The most commonly eaten foods were bread, cookies, cold cereal, and potato chips—all eaten by more than 44 percent of the children on the recall day.

Briefly, the median same-day test-retest reliability Kappa was 0.85, and item validity—as measured by the median Kappa statistic comparing student choices with those of staff nutritionists—was 0.54 *(27)*. The final food checklist items shown in table 1 consisted of 40 items (4 single foods, 25 food categories, 2 beverages, 3 single condiments, and 6 condiment groups).

Discussion

The major finding of this study is that the 40-item prototype food checklist developed to serve as a surrogate to the 24-hour recall was feasible. Nearly half of the items on the original checklist had no appreciable effects on regressions for total fat, saturated fat, and sodium intake levels—even after extensive efforts had been made to identify all possible foods that might have such an influence.

The checklist is useful but it has limitations. For example, it is difficult to code mixed dishes such as pizza and spaghetti with meat sauce accurately since individual recipes may vary greatly in their fat and sodium contents from one setting to another. Therefore, individual scores may need to be adjusted when the checklist is used with other populations. Portion size and frequency of consumption were not specified on the food checklist; but they may have influenced intakes of target nutrients reported in 24-hour recalls. Coders may have been inaccurate in identifying checklist items from information on recalls; although when the checklist is used with other populations, we believe such errors were small.

The food checklist we developed was designed to assess group level differences by gender or between intervention and control groups, and not

individual intakes. Since this checklist asks only about 1-day's intake, a single administration cannot be used to assess habitual dietary intakes of individuals. There is a large intra-individual variation in diet, so information from a single day's intake—either by 24-hour recall or by food checklist—is an efficient way to rank individuals' habitual nutrient intake. This also can be used to study the associations between intakes and physiological or behavioral risk factors. It is possible that multiple administrations of the food checklist would be better indicators of "usual" intakes of the nutrients studied. However, this hypothesis needs to be examined and tested further. The food checklist must be administered to large samples to obtain the same degree of precision in detecting differences in relative intake levels from group to group that would be achieved using the 24-hour recall.

Food checklists like the one we have developed are somewhat time- and population-specific because food availability and eating habits differ between groups and over time. Some groups may have consumed foods not included in the checklists that were significant contributors to intakes of targeted nutrients, or the food supply or food intake patterns may have changed over time. Therefore, food checklists, such as ours, require further testing and calibration for use with other populations, and they must be periodically updated.

The food checklist may be useful as a supplement to other tools, such as the Youth Risk Factor Behavior Surveillance System, used in population-based monitoring systems, in health care, and in educational settings when the target group is middle school students and a brief assessment of dietary intakes of fat, saturated fat, and sodium is needed *(7)*. These and other brief methods for determining dietary fat levels deserve

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consideration, keeping in mind issues of validity for the intended purpose *(31,32)*. A downloadable version of the checklist, scoring key, and administration instructions is available at the CATCH project Web site, along with other CATCH data collection forms.

Applications

Techniques described in this article can be used to develop food checklists to measure intakes of other nutrients. The food checklist presented here is a valid, reliable, and useful tool for assessing middle school students' food choices contributing to fat, saturated fat, and sodium in their diets. A copy of the checklist and procedures for administering it are available on the Internet at http://www.sph.uth.tmc.edu:8052/chprd/catch/. However, it requires further testing and calibration before it can be used with other populations.

Acknowledgments

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